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(73)特許権者　000005234
富士電機株式会社
神奈川県川崎市川崎区田辺新田１番１号
(72)発明者　鍋田　修
神奈川県川崎市川崎区田辺新田１番１号
富士電機株式会社内
(72)発明者　古庄　昇
神奈川県川崎市川崎区田辺新田１番１号
富士電機株式会社内
(74)代理人　100088339
弁理士　篠部　正治

審査官　今関　雅子

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最終頁に続く

(54)【発明の名称】　有機薄膜発光素子

(57)【特許請求の範囲】
【請求項１】絶縁性透明基板と、電極と、電荷注入層／発光層の結合体とを有し、
前記結合体は電極を介して絶縁性透明基板上に多段に積層され、
電極は正極と負極とが結合体を介して交互に配置されるとともに同一極性の電極は絶縁性透明基板上で相互に電気的に接続され、
前記結合体はその積層に際し、後段の結合体が前段の結合体を全体的に被覆してなることを特徴とする有機薄膜発光素子。
【請求項２】請求項１記載の有機薄膜発光素子において、電荷注入層／発光層の結合体は正孔注入層と発光層であることを特徴とする有機薄膜発光素子。
【請求項３】請求項１記載の有機薄膜発光素子において、電荷注入層／発光層の結合体は正孔注入層と電子注入層と前二者に挟まれた発光層であることを特徴とする有機薄膜発光素子。
【請求項４】請求項１記載の有機薄膜発光素子において、各発光層は同一の発光物質からなることを特徴とする有機薄膜発光素子。
【請求項５】請求項１記載の有機薄膜発光素子において、各電荷注入層は同一の電荷注入物質からなることを特徴とする有機薄膜発光素子。
【発明の詳細な説明】
【０００１】
【産業上の利用分野】この発明は各種表示装置の発光源として用いる有機薄膜発光素子に係り、特に信頼性に優れる有機薄膜発光素子の構造に関する。
【０００２】

【従来の技術】従来のブラウン管に代わるフラットディスプレイの需要の急増に伴い、各種表示素子の開発及び実用化が精力的に進められている。エレクトロルミネッセンス素子（以下ＥＬ素子とする）もこうしたニーズに即するものであり、特に全固体の自発発光素子として、他のディスプレイにはない高解像度及び高視認性により注目を集めている。現在、実用化されているものは、発光層にＺｎＳ／Ｍｎ系を用いた無機材料からなるＥＬ素子である。しかるに、この種の無機ＥＬ素子は発光に必要な駆動電圧が１００Ｖ以上と高いため駆動方法が複雑となり製造コストが高いといった問題点がある。また、青色発光の効率が低いため、フルカラー化が困難である。これに対して、有機材料を用いた薄膜発光素子は、発光に必要な駆動電圧が大幅に低減でき、かつ各種発光材料の適用によりフルカラー化の可能性を充分に持つことから、近年研究が活発化している。

【０００３】特に、電極／正孔注入層／発光層／電極からなる積層型において、発光剤にトリス（８－ヒドロキシキノリン）アルミニウムを、正孔注入剤に１，１′－ビス（４－Ｎ，Ｎ－ジトリアミノフェニル）シクロヘキサンを用いることにより、１０Ｖ以下の印加電圧で１０００ｃｄ／ｍ^2 以上の輝度が得られたという報告がなされて以来開発に拍車がかけられた（Appl.Phys.Lett. 51,913,(1987)）。

【０００４】

【発明が解決しようとする課題】この様に、有機材料を用いた薄膜発光素子は低電圧駆動やフルカラー化の可能性等を強く示唆しているものの、性能面で解決しなければならない課題が多く残されている。特に約１万時間の長時間駆動に伴う特性劣化の問題は乗り越えなければならない課題である。また、フルカラー化におけるＲＧＢ三原色の発光を可能にする発光材料の開発、また有機層の膜厚が１μｍ以下であるために、成膜性が良好でピンホール等の電気的欠陥がなく、電子，正孔の輸送能力に優れた有機材料の開発、有機層への電荷の注入性に優れる電極材料の選択等がある。

【０００５】さらには量産性の観点から大量製造が可能で安価な有機材料の開発や素子形成方法の改良等も重要な課題である。現在劣化機構の解明を中心に研究が進められ、連続駆動時の雰囲気依存性の検討から大気中の水分により上部電極と有機膜界面の剥離が発生し、これが劣化原因となる等の推測や、駆動時の電流密度の低減により劣化速度が低減し、寿命の向上に繋がるといった知見が得られつつある。

【０００６】この発明は上述の点に鑑みてなされその目的は、大気中の水分の影響を受けにくい上に電流密度を低減することが可能な素子構造を開発することにより信頼性に優れる有機薄膜発光素子を提供することにある。

【０００７】

【課題を解決するための手段】上述の目的はこの発明によれば、絶縁性透明基板と、電極と、電荷注入層／発光層の結合体とを有し、前記結合体は電極を介して絶縁性透明基板上に多段に積層され、電極は正極と負極とが結合体を介して交互に配置されるとともに同一極性の電極は絶縁性透明基板上で相互に電気的に接続され、前記結合体はその積層に際し、後段の結合体が前段の結合体を全体的に被覆してなるとすることにより達成される。

【０００８】

【作用】電荷注入層／発光層の結合体が多段に積層されているので各段の輝度を低くし且つ各段の結合体の輝度を積分して全体の輝度を高めることができる。従って各段の結合体に印加される電圧を低くし各段の電流密度を下げて駆動することが可能となる。

【０００９】また前段の結合体は後段の結合体により全体的に被覆されるので前段の結合体には大気中より水分が拡散せず電極の剥離による素子劣化を防ぐことができる。

【００１０】

【実施例】図１はこの発明の実施例に係る有機薄膜発光素子を示す断面図である。図２はこの発明の異なる実施例に係る有機薄膜発光素子を示す断面図である。図３はこの発明のさらに異なる実施例に係る有機薄膜発光素子を示す断面図である。

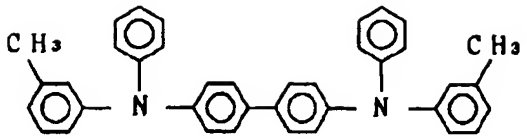
【００１１】図４はこの発明のさらに異なる実施例に係る有機薄膜発光素子を示す断面図である。１１，２１，３１，４１は絶縁性透明基板、１２，１８，２５，３６，４６，５２は正極、１３，１７，２４，２６，３５，３７，４４，４７，５１は正孔注入層、１４，１６，２３，２７，３４，３８，４３，４８，５０は発光層、１５，２２，２８，３２，４２，４９，３００は負極、３３，３９は電子注入層、１９，２９，３０１，４５は直流電源である。

【００１２】絶縁性透明基板は素子の支持体であるガラス，樹脂等を用いる。発光面となるときは透明な材料を用いる。正極は金，ニッケル等の半透膜やインジウムスズ酸化物（ＩＴＯ），酸化スズ（SnO_2）等の透明導電膜からなり抵抗加熱蒸着、電子ビーム蒸着、スパック法により形成する。該正極は、透明性を持たせるために、１００～３０００Åの厚さにすることが望ましい。

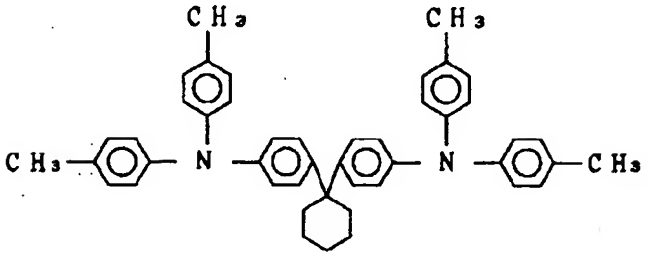
【００１３】正孔注入層は正孔を効率良く輸送し、且つ注入することが必要で発光した光の発光極大領域においてできるだけ透明であることが望ましい。成膜方法としてスピンコート、キャスティング、ＬＢ法、抵抗加熱蒸着、電子ビーム蒸着等があるが抵抗加熱蒸着が一般的である。膜厚は１００ないし２０００Åであり、好適には２００ないし８００Åである。正孔注入物質としてはヒドラゾン化合物，ピラゾリン化合物，スチルベン化合物，アミン系化合物などが用いられる。代表的な正孔注入物質が以下に示される。

【００１４】

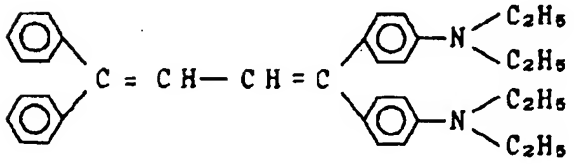
【化１】



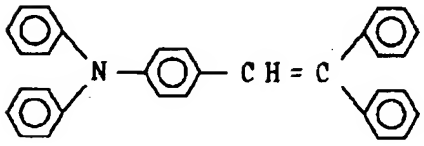
(5-1)



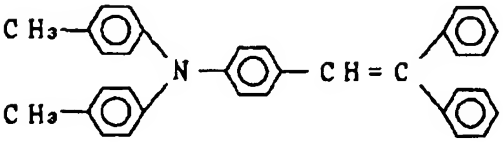
(5-2)



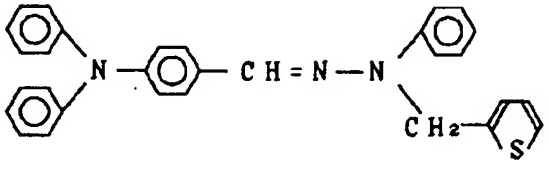
(5-3)



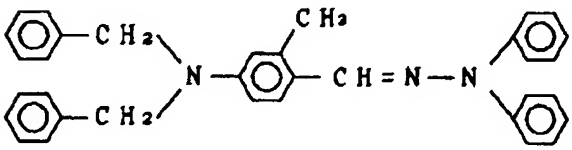
(5-4)



(5-5)



(5-6)



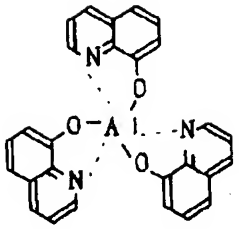
(5-7)

【００１５】発光層は正孔注入層または正極から注入された正孔と、負極または電子注入層より注入された電子の再結合により効率良く発光を行う。成膜方法はスピンコート、キャスティング、ＬＢ法、抵抗加熱蒸着、電子ビーム蒸着等があるが抵抗加熱蒸着が一般的である。膜厚は１００ないし２０００Åであるが好適には２００ないし８００Åである。代表的な発光物質が以下に示される。

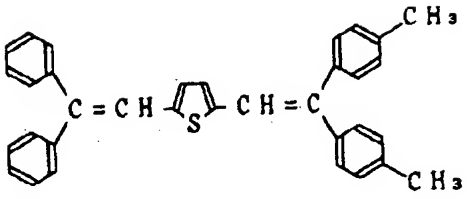
【００１６】

【化２】

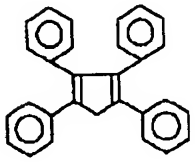
7　　8



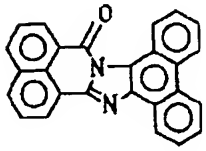
（６－１）



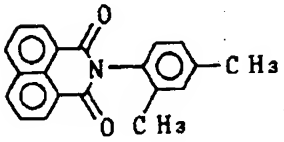
（６－２）



（６－３）



（６－４）



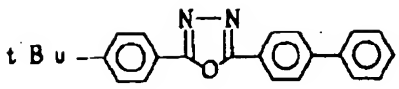
（６－５）

【００１７】電子注入層は電子を効率良く発光層に注入することが望ましい。成膜方法はスピンコート、キャスティング、ＬＢ法、抵抗加熱蒸着、電子ビーム蒸着等があるが抵抗加熱蒸着が一般的である。膜厚は１００ないし２０００Åであるが好適には２００ないし８００Åである。電子注入物質としてはオキサジアゾール誘導体，ペリレン誘導体などが用いられる。以下に代表的な電子注入物質が示される。

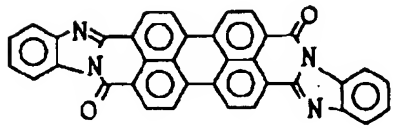
【００１８】

【化３】

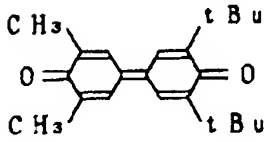
9　　10



（７－１）



（７－２）



（７－３）

【００１９】負極は電子を効率良く有機層に注入することが必要である。成膜方法としては抵抗加熱蒸着，電子ビーム蒸着，スパッタ法が用いられる。負極用材料としては仕事関数の小さいＭｇ，Ａｇ，Ｉｎ，Ｃａ，Ａｌ等およびこれらの合金，積層体，Ａｌを添加した酸化亜鉛等が用いられる。Ａｌを添加した酸化亜鉛は電子ビーム蒸着，スパッタ法によりＡｌ添加量０．５ないし３％の範囲とし基板温度２００℃以下、好適には１００℃以下で成膜することが好ましい。厚さは１００ないし２０００Å厚さに形成する。Ａｌ等の半透膜は抵抗加熱蒸着法で３００ないし８００Å厚さに形成する。

実施例１

図１はこの発明の実施例に係る有機薄膜発光素子を示す断面図である。膜厚約１０００ÅのＩＴＯである正極１２を設けたガラス基板１１を抵抗加熱蒸着装置内に載置し、正孔注入層１３、発光層１４と順次成膜した。成膜に際して、真空槽内圧は8×10^{-4} Ｐａとした。正孔注入層１３には前記化学式（５－１）に示される化合物を用いボート温度２００℃、成膜速度２Å／ｓにて５００Å厚さに形成した。続けて発光層１４として前記化学式（６－１）に示される化合物を用いボート温度約２００℃にて加熱し、成膜速度を約２Å／ｓとして６００Å厚さに形成した。

【００２０】この後、基板１１を真空槽から取り出し、スパッタ装置内に載置し、亜鉛ペレット上にＡｌワイヤを載せた試料をターゲットとしてＡｒ：O_2 ＝１：１の混合ガスを流しながらスパッタし、Ａｌ添加酸化亜鉛からなる透明な負極１５を１０００Å厚さに形成した。このＡｌ添加酸化亜鉛透明負極１５の可視光線透過率は約８５％である。次に試料をスパッタ装置から取り出し、再度抵抗加熱蒸着装置内に載置し、前記発光層１４、正孔注入層１３と同一の材料を用いて、同一の条件下で発光層１６、正孔注入層１７の順に５００Åの厚さに形成した。最後に正極１８としてＡｇを１０００Åの厚さに形成した。

比較例１

上記実施例において発光層１６、正孔注入層１７、正極１８を形成しない他は実施例１と同様にして有機薄膜発光素子を形成した。

【００２１】実施例１と比較例１の両者とも直流電圧を印加したところ緑色（中心波長：５５０ｎｍ）の均一な発光が得られた。輝度１００ｃｄ／m^2 における電圧、電流密度、発光効率、輝度半減時間を表１に示す。

【００２２】

【表１】

50

	初期特性				輝度半減時間（h）
	初期輝度（cd/m²）	電　圧（V）	電流密度（mA/cm²）	発光効率（lm/W）	
実施例１	１００	10.7	2.8	0.52	８８０
比較例１	１００	12.5	5.0	0.50	２００

本実施例においては正孔注入層と発光層からなる結合体が二段積層されているために、単一の結合体が負担する輝度は低くてすみ、そのために単一の結合体が必要とする電流密度の低減することができ、有機薄膜発光素子全体として寿命が向上する。さらに二段目の結合体は一段目の結合体を全体的に被覆するので一段目の結合体への水分の侵入が阻止され、有機薄膜発光素子の信頼性が向上する。

【００２３】また素子に係る電圧は比較例の一段素子に比し低減できるから、発光効率においても同等か、若干の向上がみられる。

実施例２

図２はこの発明の異なる実施例に係る有機薄膜発光素子を示す断面図である。ガラス基板２１上にＡｌ添加酸化亜鉛からなる透明な負極２２を膜厚約１０００Åの厚さに設けた。次に発光層２３と正孔注入層２４を順次成膜した。発光層２３と、正孔注入層２４は実施例１と同一の条件で作成した。

【００２４】正極２５はＡｕを用い、同じ抵抗加熱蒸着装置を用い７００Å厚さに形成した。この正極の光透過率は約７０％である。引き続いて正孔注入層２６と発光層２７を前記と同様にして順次作成した。最後に負極２８をＭｇとＡｇの合金（Ｍｇ／Ａｇ＝１０：１）を用いて１０００Å厚さに抵抗加熱蒸着法により形成した。

比較例２

上記実施例において正孔注入層２６、発光層２７、負極２８を形成しない他は実施例２と同様にして有機薄膜発光素子を形成した。

【００２５】実施例２と比較例２の両者とも直流電圧を印加したところ緑色（中心波長：５５０ｎｍ）の均一な発光が得られた。輝度１００ｃｄ／ｍ² における電圧、電流密度、発光効率、輝度半減時間を表２に示す。

【００２６】

【表２】

	初期特性				輝度半減時間（h）
	初期輝度（cd/m²）	電　圧（V）	電流密度（mA/cm²）	発光効率（lm/W）	
実施例２	１００	10.5	3.55	0.35	８２０
比較例２	１００	13.6	6.3	0.36	１９３

実施例３

図３はこの発明のさらに異なる実施例に係る有機薄膜発光素子を示す断面図である。ガラス基板３１上にＡｌ添加酸化亜鉛からなる透明な負極３２を膜厚約１０００Åの厚さに設けた。次に電子注入層３３、発光層３４、正孔注入層３５を順次成膜した。電子注入層は前記化学式（７－２）を用いボート温度約３００℃で加熱し、成膜速度２Å／ｓとして４００Å厚さに形成した。発光層３４と、正孔注入層３５は実施例１と同一の条件で作成した。

【００２７】正極３６はＡｕを用い、同じ抵抗加熱蒸着装置を用い７００Å厚さに形成した。この正極の光透過率は約７０％である。引き続いて正孔注入層３７と発光層３８と電子注入層３９を前記と同様にして順次作成した。　最後に負極３００をＭｇとＡｇの合金（Ｍｇ／Ａｇ＝１０：１）を用いて１０００Å厚さに抵抗加熱蒸着法により形成した。

比較例３

上記実施例３において正孔注入層３７、発光層３８、負極３００を形成しない他は実施例３と同様にして有機薄膜発光素子を形成した。

【００２８】実施例３と比較例３の両者とも直流電圧を

印加したところ緑色（中心波長：５５０ｎｍ）の均一な発光が得られた。輝度１００ｃｄ／ｍ² における電圧、電流密度、発光効率、輝度半減時間を表３に示す。

【００２９】

【表３】

	初期特性				輝度半減時間（h）
	初期輝度（cd/m²）	電　圧（V）	電流密度（mA/cm²）	発光効率（lm/W）	
実施例３	１００	12.3	3.40	0.38	８５０
比較例３	１００	13.1	6.1	0.39	１９５

実施例４

図４はこの発明のさらに異なる実施例に係る有機薄膜発光素子を示す断面図である。ガラス基板４１上にＡｌ添加酸化亜鉛からなる透明な負極４２を膜厚約１０００Åの厚さに設けた。次に発光層４３と正孔注入層４４を順次成膜した。発光層４３と、正孔注入層４４は実施例１と同一の条件で作成した。

【００３０】正極４６はＡｕを用い、同じ抵抗加熱蒸着装置を用い７００Å厚さに形成した。この正極の光透過率は約７０％である。引き続いて正孔注入層４７、発光層４８、負極４９、発光層５０、正孔注入層５１を前記と同様にして作成した。正極５２はＡｇを１０００Å形成した。本素子は正孔注入層と発光層の結合体が三組積層されている。

比較例４

前記比較例２と同一である。

【００３１】実施例４と比較例４の両者とも直流電圧を印加したところ緑色（中心波長：５５０ｎｍ）の均一な発光が得られた。輝度１００ｃｄ／ｍ² における電圧、電流密度、発光効率、輝度半減時間を表４に示す。

【００３２】

【表４】

	初期特性				輝度半減時間（h）
	初期輝度（cd/m²）	電　圧（V）	電流密度（mA/cm²）	発光効率（lm/W）	
実施例４	１００	9.3	2.4	0.47	１３００
比較例４	１００	12.5	5.0	0.50	２００

【００３３】

【発明の効果】この発明によれば絶縁性透明基板と、電極と、電荷注入層／発光層の結合体とを有し、前記結合体は電極を介して絶縁性透明基板上に多段に積層され、電極は正極と負極とが結合体を介して交互に配置されるとともに同一極性の電極は絶縁性透明基板上で相互に電気的に接続され、前記結合体はその積層に際し、後段の結合体が前段の結合体を全体的に被覆してなるので、電荷注入層／発光層の結合体各段の輝度を低くし且つ各段の結合体の輝度を積分して素子全体の輝度を高めることができる。従って各段の結合体に印加される電圧を低くし各段の電流密度を下げて駆動することができ信頼性に優れる有機薄膜発光素子が得られる。

【００３４】また有機薄膜発光素子の結合体積層において前段にある結合体は後段の結合体により全体的に被覆されるので前段の結合体には大気中より水分が拡散せず電極の剥離による素子劣化を防ぐことができ信頼性に優れる有機薄膜発光素子が得られる。

【図面の簡単な説明】

【図１】この発明の実施例に係る有機薄膜発光素子を示す断面図

【図２】この発明の異なる実施例に係る有機薄膜発光素子を示す断面図

【図３】この発明のさらに異なる実施例に係る有機薄膜発光素子を示す断面図

【図４】この発明のさらに異なる実施例に係る有機薄膜発光素子を示す断面図

【符号の説明】

15

１１，２１，３１，４１　絶縁性透明基板
１２，１８，２５，３６，４６，５２　正極
１３，１７，２４，２６，３５，３７，４４，４７，５１　正孔注入層
１４，１６，２３，２７，３４，３８，４３，４８，５０　発光層
１５，２２，２８，３２，４２，４９，３００　負極
３３，３９　電子注入層
１９，２９，３０１，４５　直流電源

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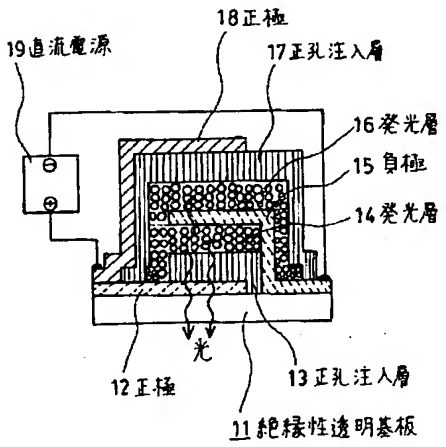
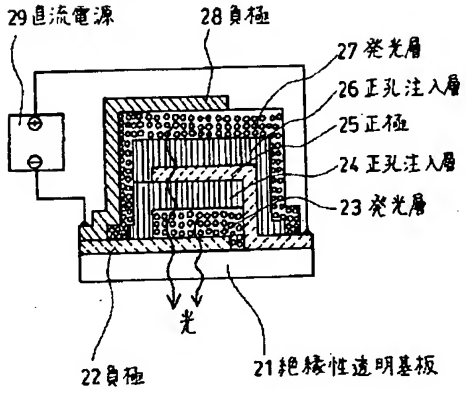
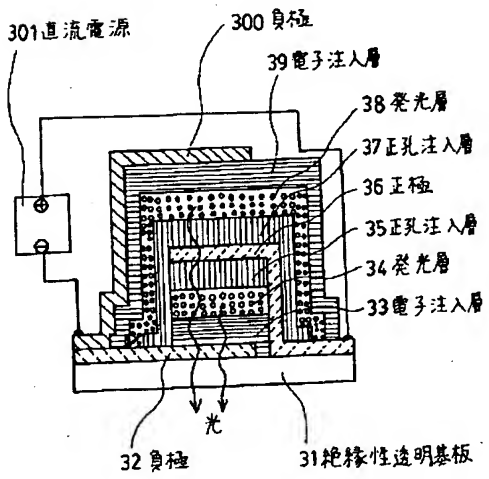
【図１】



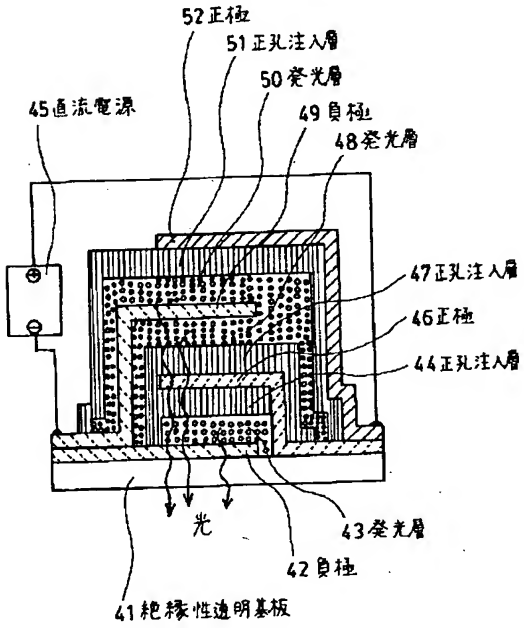
【図２】



【図３】



【図４】



フロントページの続き

(58)調査した分野(Int.Cl.[7]，ＤＢ名)
H05B　33/00 - 33/28

CLAIMS

(57) [Claim(s)]

[Claim 1] Have the following and the laminating of the aforementioned joint object is carried out to multi-stage on an insulating transparent substrate through an electrode. It is the organic thin film light emitting device to which a latter joint object, on the whole, covers the joint object of the preceding paragraph on the occasion of the laminating, and the aforementioned joint object is characterized by the bird clapper by connecting the same polar electrode mutually electrically on an insulating transparent substrate while, as for an electrode, a positive electrode and a negative electrode are arranged by turns through a joint object. Insulating transparent substrate Electrode The joint object of a charge pouring layer / luminous layer

[Claim 2] It is the organic thin film light emitting device characterized by the joint objects of a charge pouring layer / luminous layer being a hole-injection layer and a luminous layer in an organic thin film light emitting device according to claim 1.

[Claim 3] It is the organic thin film light emitting device characterized by being the luminous layer by which the joint object of a charge pouring layer / luminous layer was inserted into a hole-injection layer, an electron-injection layer, and front 2 persons in the organic thin film light emitting device according to claim 1.

[Claim 4] It is the organic thin film light emitting device characterized by the bird clapper from a photogene with each same luminous layer in an organic thin film light emitting device according to claim 1.

[Claim 5] It is the organic thin film light emitting device characterized by the bird clapper from the charge pouring matter with each same charge pouring layer in an organic thin film light emitting device according to claim 1.

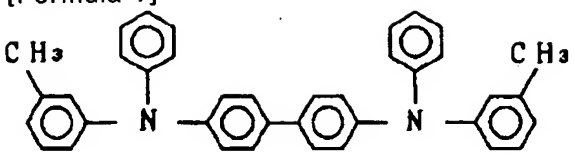
[Translation done.]

DETAILED DESCRIPTION

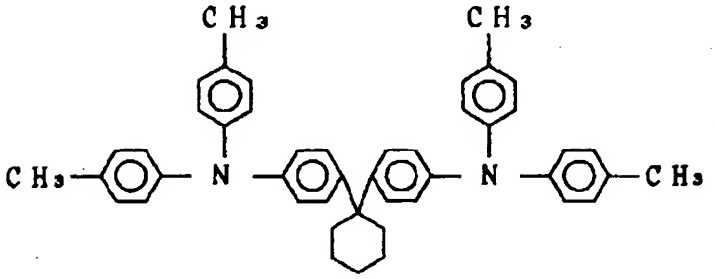
[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the structure of the organic thin film light emitting device which starts the organic thin film light emitting device used as a source of luminescence of various display, especially is excellent in reliability.
[0002]
[Description of the Prior Art] Development and utilization of various display devices are energetically advanced with rapid increase of the need of the flat display which replaces the conventional Braun tube. Electroluminescent element (it considers as an EL element below) is also based on such needs, and attention is attracted by the high resolution and the high visibility it is especially invisible on other displays as a spontaneous light emitting device of all solid-states. Now, what is put in practical use is an EL element which consists of inorganic material which used the ZnS/Mn system for the luminous layer. However, since this kind of inorganic EL element has driver voltage [required for luminescence] as high as more than 100V, the drive method becomes complicated and it has the trouble that a manufacturing cost is high. Moreover, for a low reason, the efficiency of blue luminescence is difficult for full-color-izing. On the other hand, since driver voltage required for luminescence can reduce sharply the thin film light emitting device using the organic material and it fully has the possibility of full-color-izing by application of various luminescent material, research is activating it in recent years.
[0003] In the laminating type which consists of an electrode / hole-injection layer / a luminous layer / an electrode especially to a luminescence agent tris (8-hydroxyquinoline) aluminum By using a 1 and 1'-screw (4-N and N-JITORI aminophenyl) cyclohexane for a hole-injection agent It is 1000 cd/m2 at the applied voltage not more than 10V. Since the report that the above brightness was obtained was made, the spur has been applied to development (Appl.Phys.Lett.51, 913, (1987)).
[0004]
[Problem(s) to be Solved by the Invention] Thus, although the thin film light emitting device using the organic material has suggested strongly a low-battery drive, the possibility of full-color-izing, etc., many technical problems which must be solved in respect of a performance are left behind. Especially the problem of property degradation accompanying the prolonged drive of about 10,000 hours is a technical problem which must be overcome. Moreover, since development of the luminescent material which enables luminescence of RGB three primary colors in full-color-izing, and the thickness of an organic layer are 1 micrometer or less, membrane formation nature is good, there are no electric defects, such as a pinhole, and there is selection of the electrode material which is excellent in development of the organic material excellent in the transport capacity of an electron and an electron hole and the pouring nature of the charge to an organic layer etc.
[0005] Development of an organic material still more possible [the viewpoint of mass-production nature to extensive manufacture] and cheap, improvement of the element formation method, etc. are important technical problems. Research is advanced focusing on the elucidation of the present degradation mechanism, ablation of an up electrode and an organic film interface occurs with the moisture in the atmosphere from examination of the

atmosphere dependency at the time of a continuation drive, degradation speed decreases by the guess of this causing degradation, and reduction of the current density at the time of a drive, and the knowledge of being connected to improvement in a life is being acquired.
[0006] This invention is made in view of an above-mentioned point, and the purpose is in offering the organic thin film light emitting device which is excellent in reliability by developing the element structure which it is hard to be influenced upwards of the moisture in the atmosphere, and can reduce current density.
[0007]
[Means for Solving the Problem] According to this invention, the above-mentioned purpose has an insulating transparent substrate, an electrode, and the joint object of a charge pouring layer / luminous layer. The laminating of the aforementioned joint object is carried out to multi-stage on an insulating transparent substrate through an electrode, and while, as for an electrode, a positive electrode and a negative electrode are arranged by turns through a joint object, the same polar electrode is mutually connected electrically on an insulating transparent substrate. The aforementioned joint object is attained by supposing that a latter joint object, on the whole, comes to cover the joint object of the preceding paragraph on the occasion of the laminating.
[0008]
[Function] Since the laminating of the joint object of a charge pouring layer / luminous layer is carried out to multi-stage, the brightness of each stage can be made low, and it can integrate with the brightness of the joint object of each stage, and the whole brightness can be raised. Therefore, voltage impressed to the joint object of each stage is made low, and it becomes possible to lower and drive the current density of each stage.
[0009] Moreover, since the joint object of the preceding paragraph is covered with a latter joint object on the whole, on the joint object of the preceding paragraph, moisture does not diffuse it, but it can protect element degradation by ablation of an electrode from the inside of the atmosphere on it.
[0010]
[Example] Drawing 1 is the cross section showing the organic thin film light emitting device concerning the example of this invention. Drawing 2 is the cross section showing the organic thin film light emitting device concerning the example from which this invention differs. Drawing 3 is the cross section showing the organic thin film light emitting device concerning the example from which this invention differs further.
[0011] Drawing 4 is the cross section showing the organic thin film light emitting device concerning the example from which this invention differs further. An insulating transparent substrate, and 12, 18, 25, 36, 46 and 52 11, 21, 31, and 41 A positive electrode, 13, 17, 24, 26, 35, 37, 44, 47, and 51 A hole-injection layer, As for a negative electrode, and 33 and 39, for 14, 16, 23, 27, 34, 38, 43, 48, and 50, an electron-injection layer, and 19, 29, 301 and 45 are [a luminous layer, and 15, 22, 28 32, 42 and 49,300] DC power supplies.
[0012] An insulating transparent substrate uses glass, a resin, etc. which are the base material of an element. A transparent material is used when becoming a luminescence side. A positive electrode consists of transparent electric conduction films, such as semipermeable membrane, such as gold and nickel, and an indium stannic-acid ghost (ITO), tin oxide (SnO_2), and is formed by resistance heating vacuum evaporationo, electron beam evaporation, and the spatter. In order to give transparency, as for this positive electrode, it is desirable to make it the thickness of 100-3000A.
[0013] A hole-injection layer has a desirable thing transparent as much as possible in the luminescence maximum field of light to which it was required in which to convey an electron hole efficiently and to pour it in, and it emitted light. Although there are SUPINKO-TO, casting, the LB method, resistance heating vacuum evaporationo, electron beam evaporation, etc. as the membrane formation method, resistance heating vacuum evaporationo is common. Thickness is 100 or 2000A and is 200 or 800A suitably. As hole-injection matter, a hydrazone compound, a pyrazoline compound, a stilbene compound, an amine system compound, etc. are used. The typical hole-injection matter is shown below.

[0014]
[Formula 1]



(5 - 1)



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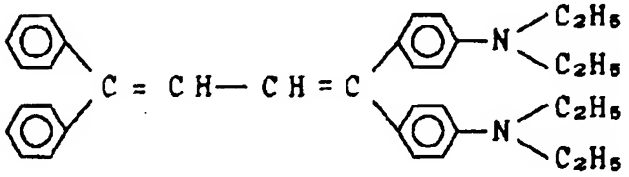

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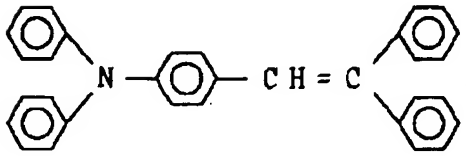

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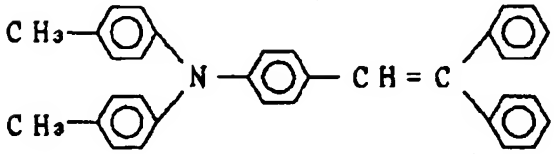

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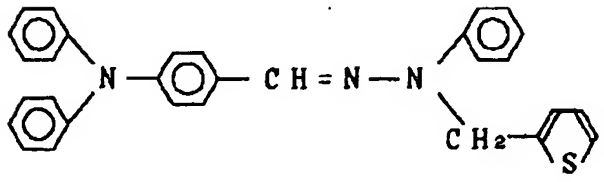

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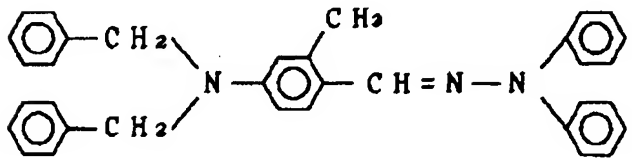
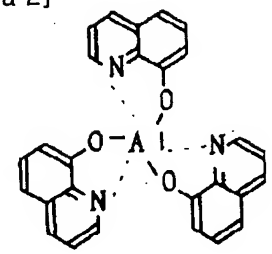


(5 - 7)

[0015] A luminous layer emits light efficiently by the reunion of the electron hole poured in from the hole-injection layer or the positive electrode, and the electron poured in from the negative electrode or the electron-injection layer. Although the membrane formation method has SUPINKO-TO, casting, the LB method, resistance heating vacuum evaporationo, electron beam evaporation, etc., its resistance heating vacuum evaporationo is common. Although

thickness is 100 or 2000A, it is 200 or 800A suitably. A typical photogene is shown below.
[0016]
[Formula 2]



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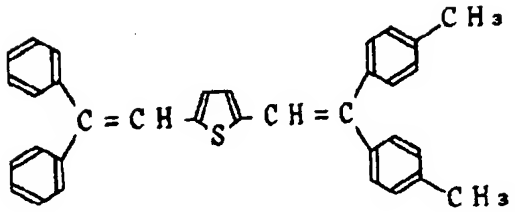

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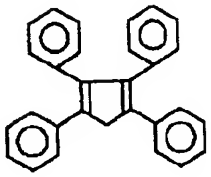

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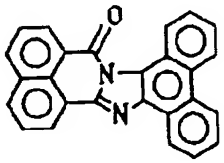

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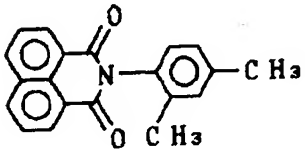
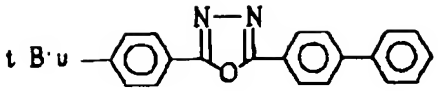


(6 - 5)

[0017] As for an electron-injection layer, it is desirable to pour an electron into a luminous layer efficiently. Although the membrane formation method has SUPINKO-TO, casting, the LB method, resistance heating vacuum evaporationo, electron beam evaporation, etc., its resistance heating vacuum evaporationo is common. Although thickness is 100 or 2000A, it is 200 or 800A suitably. An OKISA diazole derivative, a perylene derivative, etc. are used as electron-injection matter. The typical electron-injection matter is shown below.
[0018]
[Formula 3]



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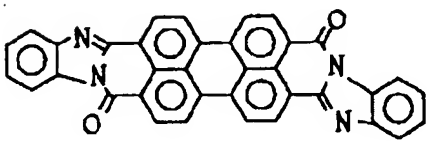

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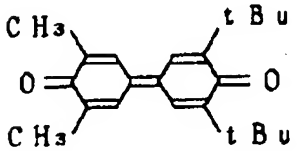


(7 - 3)

[0019] A negative electrode needs to inject an electron into an organic layer efficiently. As the membrane formation method, resistance heating vacuum evaporationo, electron beam evaporation, and a spatter are used. The zinc oxide which added these alloys and a layered product, and aluminum, such as Mg, Ag, In, calcium, aluminum, etc. with a small work function, as a charge of negative-electrode material is used. As for the zinc oxide which added aluminum, it is desirable to consider as the aluminum addition 0.5 or 3% of range by electron beam evaporation and the spatter, and to form membranes below 100 degrees C suitably the substrate temperature of 200 degrees C or less. Thickness is formed in 100 or 2000A thickness. Semipermeable membrane, such as aluminum, is formed in 300 or 800A thickness by the resistance heating vacuum deposition.

Example 1 drawing 1 is the cross section showing the organic thin film light emitting device concerning the example of this invention. The glass substrate 11 which formed the positive electrode 12 which is ITO of about 1000A of thickness was laid in resistance heating vacuum evaporationo equipment, and membranes were formed one by one with the hole-injection layer 13 and the luminous layer 14. Vacuum tub internal pressure was set to 8x10 to 4 Pa on the occasion of membrane formation. It formed in 500A thickness using the compound shown in the aforementioned chemical formula (5-1) at the hole-injection layer 13 by 2A/s in the boat temperature of 200 degrees C, and membrane formation speed. It heated at the boat temperature of about 200 degrees C using the compound continuously shown in the aforementioned chemical formula (6-1) as a luminous layer 14, membrane formation speed was carried out in about 2A/s, and it formed in 600A thickness.

[0020] Then, the substrate 11 was taken out from the vacuum tub and it laid in the sputtering system, and the spatter was carried out by using as a target the sample which carried aluminum wire on the zinc pellet, passing the mixed gas of Ar:O 2 = 1:1, and the transparent negative electrode 15 which consists of an aluminum addition zinc oxide was formed in 1000A thickness. The visible-ray permeability of this aluminum addition zinc-oxide transparent negative electrode 15 is about 85%. Next, the sample was taken out from the sputtering system, and it laid in resistance heating vacuum evaporationo equipment again, and formed in the thickness of 500A in order of the luminous layer 16 and the hole-injection layer 17 under the same conditions using the same material as the aforementioned luminous layer 14 and the hole-injection layer 13. Finally Ag was formed in the thickness of 1000A as a positive electrode 18.

In the example of comparison 1 above-mentioned example, a luminous layer 16, the hole-injection layer 17, and a positive electrode 18 were not formed, and also the organic thin film

light emitting device was formed like the example 1.
[0021] When both example 1 and example 1 of comparison impressed direct current voltage, uniform green (main wavelength : 550nm) luminescence was obtained. Brightness 100 cd/m2 The voltage which can be set, current density, luminous efficiency, and brightness half line are shown in Table 1.
[0022]
[Table 1]

	初期特性				輝度半減時間 (h)
	初期輝度 (cd/m²)	電 圧 (V)	電流密度 (mA/cm²)	発光効率 (lm/W)	
実施例1	100	10.7	2.8	0.52	880
比較例1	100	12.5	5.0	0.50	200

Since the two-step laminating of the joint object which consists of a hole-injection layer and a luminous layer in this example is carried out, the brightness which a single joint object pays can be low, can end, and can reduce the current density which a joint object single for the reason needs, and its life improves as the organic whole thin film light emitting device. Since joint [the first step of] object is covered on the whole, the invasion of the moisture to joint [the first step of] object is prevented, and the reliability of joint [the second more step of] object of an organic thin film light emitting device improves.
[0023] Moreover, since the voltage concerning an element is compared with the one-step element of the example of comparison and it can decrease, equivalent [in luminous efficiency] or the improvement in some is found.
Example 2 drawing 2 is the cross section showing the organic thin film light emitting device concerning the example from which this invention differs. The transparent negative electrode 22 which consists of an aluminum addition zinc oxide was formed on the glass substrate 21 at the thickness of about 1000A of thickness. Next, the luminous layer 23 and the hole-injection layer 24 were formed one by one. The luminous layer 23 and the hole-injection layer 24 were created on the same conditions as an example 1.
[0024] The positive electrode 25 was formed in 700A thickness using the same resistance heating vacuum evaporationo equipment using Au. The light transmittance of this positive electrode is about 70%. The hole-injection layer 26 and the luminous layer 27 were succeedingly created one by one like the above. Finally, the alloy (Mg/Ag=10:1) of Mg and Ag was used and the negative electrode 28 was formed in 1000A thickness by the resistance heating vacuum deposition.
In the example of comparison 2 above-mentioned example, the hole-injection layer 26, a luminous layer 27, and a negative electrode 28 were not formed, and also the organic thin film light emitting device was formed like the example 2.
[0025] When both example 2 and example 2 of comparison impressed direct current voltage, uniform green (main wavelength : 550nm) luminescence was obtained. Brightness 100 cd/m2 The voltage which can be set, current density, luminous efficiency, and brightness half line are shown in Table 2.
[0026]
[Table 2]

	初期特性				輝度半減時間 (h)
	初期輝度 (cd/m²)	電 圧 (V)	電流密度 (mA/cm²)	発光効率 (lm/W)	
実施例2	100	10.5	3.55	0.35	820
比較例2	100	13.6	6.3	0.36	193

Example 3 drawing 3 is the cross section showing the organic thin film light emitting device concerning the example from which this invention differs further. The transparent negative electrode 32 which consists of an aluminum addition zinc oxide was formed on the glass substrate 31 at the thickness of about 1000A of thickness. Next, the electron-injection layer 33, the luminous layer 34, and the hole-injection layer 35 were formed one by one. The electron-injection layer was heated at the boat temperature of about 300 degrees C using the aforementioned chemical formula (7-2), and was formed in 400A thickness as 2A/s in membrane formation speed. The luminous layer 34 and the hole-injection layer 35 were created on the same conditions as an example 1.

[0027] The positive electrode 36 was formed in 700A thickness using the same resistance heating vacuum evaporationo equipment using Au. The light transmittance of this positive electrode is about 70%. The hole-injection layer 37, the luminous layer 38, and the electron-injection layer 39 were succeedingly created one by one like the above. Finally, the alloy (Mg/Ag=10:1) of Mg and Ag was used and the negative electrode 300 was formed in 1000A thickness by the resistance heating vacuum deposition.

In the example of comparison 3 above-mentioned example 3, the hole-injection layer 37, a luminous layer 38, and a negative electrode 300 were not formed, and also the organic thin film light emitting device was formed like the example 3.

[0028] When both example 3 and example 3 of comparison impressed direct current voltage, uniform green (main wavelength : 550nm) luminescence was obtained. Brightness 100 cd/m2 The voltage which can be set, current density, luminous efficiency, and brightness half line are shown in Table 3.

[0029]

[Table 3]

	初期特性				輝度半減時間 (h)
	初期輝度 (cd/m²)	電 圧 (V)	電流密度 (mA/cm²)	発光効率 (lm/W)	
実施例3	100	12.3	3.40	0.38	850
比較例3	100	13.1	6.1	0.39	195

Example 4 drawing 4 is the cross section showing the organic thin film light emitting device concerning the example from which this invention differs further. The transparent negative electrode 42 which consists of an aluminum addition zinc oxide was formed on the glass substrate 41 at the thickness of about 1000A of thickness. Next, the luminous layer 43 and the hole-injection layer 44 were formed one by one. The luminous layer 43 and the hole-injection layer 44 were created on the same conditions as an example 1.

[0030] The positive electrode 46 was formed in 700A thickness using the same resistance heating vacuum evaporationo equipment using Au. The light transmittance of this positive electrode is about 70%. The hole-injection layer 47, the luminous layer 48, the negative electrode 49, the luminous layer 50, and the hole-injection layer 51 were succeedingly created like the above. The positive electrode 52 formed 1000A of Ag. As for this element, the triad laminating of the joint object of a hole-injection layer and a luminous layer is carried out. It is the same as that of the example 2 of the example of comparison 4 aforementioned comparison.

[0031] When both example 4 and example 4 of comparison impressed direct current voltage, uniform green (main wavelength : 550nm) luminescence was obtained. Brightness 100 cd/m2 The voltage which can be set, current density, luminous efficiency, and brightness half line are shown in Table 4.

[0032]

[Table 4]

	初期特性				輝度半減時間 (h)
	初期輝度 (cd/㎡)	電 圧 (V)	電流密度 (mA/cm²)	発光効率 (lm/W)	
実施例4	100	9.3	2.4	0.47	1300
比較例4	100	12.5	5.0	0.50	200

[0033]

[Effect of the Invention] According to this invention, it has an insulating transparent substrate, an electrode, and the joint object of a charge pouring layer / luminous layer. The laminating of the aforementioned joint object is carried out to multi-stage on an insulating transparent substrate through an electrode, and while, as for an electrode, a positive electrode and a negative electrode are arranged by turns through a joint object, the same polar electrode is mutually connected electrically on an insulating transparent substrate. Since a latter joint object, on the whole, comes to cover the joint object of the preceding paragraph on the occasion of the laminating, the aforementioned joint object can make low the brightness of join coalesce each stage of a charge pouring layer / luminous layer, and can integrate with the brightness of the joint object of each stage, and can raise the brightness of the whole element. Therefore, the organic thin film light emitting device which can make low voltage impressed to the joint object of each stage, can lower and drive the current density of each stage, and is excellent in reliability is obtained.

[0034] Moreover, since the joint object which is in the preceding paragraph in the joint volume layer of an organic thin film light emitting device is covered with a latter joint object on the whole, the organic thin film light emitting device which moisture is not spread from the inside of the atmosphere, but can prevent element degradation by ablation of an electrode on the joint object of the preceding paragraph, and is excellent in reliability is obtained.

[Translation done.]

TECHNICAL FIELD

[Industrial Application] This invention relates to the structure of the organic thin film light emitting device which starts the organic thin film light emitting device used as a source of luminescence of various display, especially is excellent in reliability.
[0002]

[Translation done.]

PRIOR ART

[Description of the Prior Art] Development and utilization of various display devices are energetically advanced with rapid increase of the need of the flat display which replaces the conventional Braun tube. Electroluminescent element (it considers as an EL element below) is also based on such needs, and attention is attracted by the high resolution and the high visibility it is especially invisible on other displays as a spontaneous light emitting device of all solid-states. Now, what is put in practical use is an EL element which consists of inorganic material which used the ZnS/Mn system for the luminous layer. However, since this kind of inorganic EL element has driver voltage [required for luminescence] as high as more than 100V, the drive method becomes complicated and it has the trouble that a manufacturing cost is high. Moreover, for a low reason, the efficiency of blue luminescence is difficult for full-color-izing. On the other hand, since driver voltage required for luminescence can reduce sharply the thin film light emitting device using the organic material and it fully has the possibility of full-color-izing by application of various luminescent material, research is activating it in recent years.

[0003] In the laminating type which consists of an electrode / hole-injection layer / a luminous layer / an electrode especially, tris (8-hydroxyquinoline) aluminum is used for a luminescence agent, and a 1 and 1'-screw (4-N and N-JITORI aminophenyl) cyclohexane is used for a hole-injection agent. It is 1000 cd/m2 at the applied voltage not more than 10V. Since the report that the above brightness was obtained was made, the spur has been applied to development (Appl.Phys.Lett.51, 913, (1987)).

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] While according to this invention having an insulating transparent substrate, an electrode, and the joint object of a charge pouring layer / luminous layer, carrying out the laminating of the aforementioned joint object to multi-stage on an insulating transparent substrate through an electrode and, as for an electrode, arranging a positive electrode and a negative electrode by turns through a joint object By connecting the same polar electrode mutually electrically on an insulating transparent substrate, since a latter joint object, on the whole, comes to cover the joint object of the preceding paragraph on the occasion of the laminating, the aforementioned joint object can make low the brightness of join coalesce each stage of a charge pouring layer / luminous layer, and it can integrate with the brightness of the joint object of each stage, and the brightness of the whole element can be raised. Therefore, the organic thin film light emitting device which can make low voltage impressed to the joint object of each stage, can lower and drive the current density of each stage, and is excellent in reliability is obtained.
[0034] Moreover, since the joint object which is in the preceding paragraph in the joint volume layer of an organic thin film light emitting device is covered with a latter joint object on the whole, the organic thin film light emitting device which moisture is not spread from the inside of the atmosphere, but can prevent element degradation by ablation of an electrode on the joint object of the preceding paragraph, and is excellent in reliability is obtained.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] Thus, although the thin film light emitting device using the organic material has suggested strongly a low-battery drive, the possibility of full-color-izing, etc., many technical problems which must be solved in respect of a performance are left behind. Especially the problem of property degradation accompanying the prolonged drive of about 10,000 hours is a technical problem which must be overcome. Moreover, since development of the luminescent material which enables luminescence of RGB three primary colors in full-color-izing, and the thickness of an organic layer are 1 micrometer or less, membrane formation nature is good, there are no electric defects, such as a pinhole, and there is selection of the electrode material which is excellent in development of the organic material excellent in the transport capacity of an electron and an electron hole and the pouring nature of the charge to an organic layer etc.

[0005] Development of an organic material still more possible [the viewpoint of mass-production nature to extensive manufacture] and cheap, improvement of the element formation method, etc. are important technical problems. Research is advanced focusing on the elucidation of the present degradation mechanism, exfoliation of an up electrode and an organic film interface occurs with the moisture in the atmosphere from examination of the atmosphere dependency at the time of a continuation drive, degradation speed decreases by the guess of this causing degradation, and reduction of the current density at the time of a drive, and the knowledge of being connected to improvement in a life is being acquired.

[0006] This invention is made in view of an above-mentioned point, and the purpose is in offering the organic thin film light emitting device which is excellent in reliability by developing the element structure which it is hard to be influenced upwards of the moisture in the atmosphere, and can reduce current density.

MEANS

[Means for Solving the Problem] According to this invention, the above-mentioned purpose has an insulating transparent substrate, an electrode, and the joint object of a charge pouring layer / luminous layer. The laminating of the aforementioned joint object is carried out to multi-stage on an insulating transparent substrate through an electrode, and while, as for an electrode, a positive electrode and a negative electrode are arranged by turns through a joint object, the same polar electrode is mutually connected electrically on an insulating transparent substrate. The aforementioned joint object is attained by supposing that a latter joint object, on the whole, comes to cover the joint object of the preceding paragraph on the occasion of the laminating.

[Translation done.]

OPERATION

[Function] Since the laminating of the joint object of a charge pouring layer / luminous layer is carried out to multi-stage, the brightness of each stage can be made low, and it can integrate with the brightness of the joint object of each stage, and the whole brightness can be raised. Therefore, voltage impressed to the joint object of each stage is made low, and it becomes possible to lower and drive the current density of each stage.
[0009] Moreover, since the joint object of the preceding paragraph is covered with a latter joint object on the whole, on the joint object of the preceding paragraph, moisture does not diffuse it, but it can protect element degradation by exfoliation of an electrode from the inside of the atmosphere on it.

[Translation done.]

EXAMPLE

[Example] Drawing 1 is the cross section showing the organic thin film light emitting device concerning the example of this invention. Drawing 2 is the cross section showing the organic thin film light emitting device concerning the example from which this invention differs. Drawing 3 is the cross section showing the organic thin film light emitting device concerning the example from which this invention differs further.

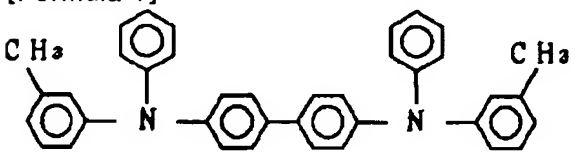
[0011] Drawing 4 is the cross section showing the organic thin film light emitting device concerning the example from which this invention differs further. An insulating transparent substrate, and 12, 18, 25, 36, 46 and 52 11, 21, 31, and 41 A positive electrode, 13, 17, 24, 26, 35, 37, 44, 47, and 51 A hole-injection layer, As for a negative electrode, and 33 and 39, for 14, 16, 23, 27, 34, 38, 43, 48, and 50, an electron-injection layer, and 19, 29, 301 and 45 are [a luminous layer, and 15, 22, 28 32, 42 and 49,300] DC power supplies.

[0012] An insulating transparent substrate uses glass, a resin, etc. which are the base material of an element. A transparent material is used when becoming a luminescence side. A positive electrode consists of transparent electric conduction films, such as semipermeable membrane, such as gold and nickel, and an indium stannic-acid ghost (ITO), tin oxide (SnO2), and is formed by resistance heating vacuum evaporationo, electron beam evaporation, and the spatter. In order to give transparency, as for this positive electrode, it is desirable to make it the thickness of 100-3000A.

[0013] A hole-injection layer has a desirable thing transparent as much as possible in the luminescence maximum field of light to which it was required in which to convey an electron hole efficiently and to pour it in, and it emitted light. Although there are SUPINKO-TO, casting, the LB method, resistance heating vacuum evaporationo, electron beam evaporation, etc. as the membrane formation method, resistance heating vacuum evaporationo is common. Thickness is 100 or 2000A and is 200 or 800A suitably. As hole-injection matter, a hydrazone compound, a pyrazoline compound, a stilbene compound, an amine system compound, etc. are used. The typical hole-injection matter is shown below.

[0014]

[Formula 1]



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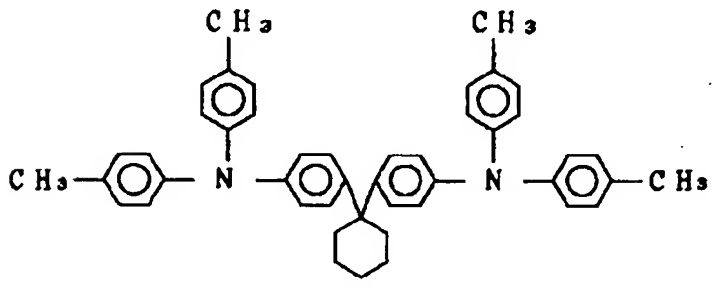

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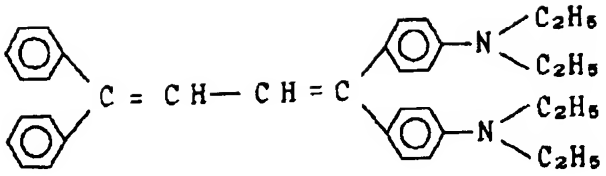

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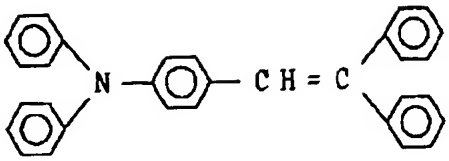

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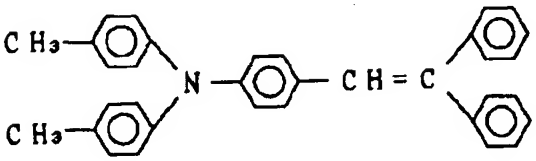

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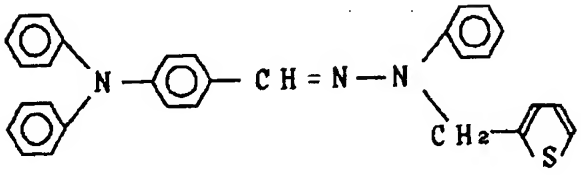

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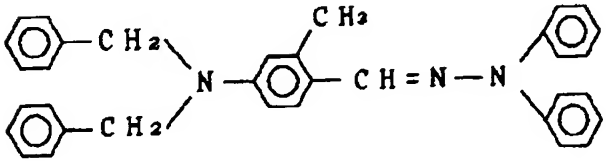
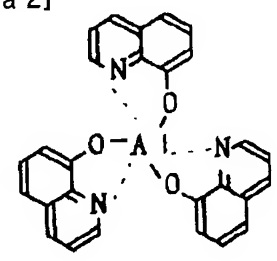


(5 - 7)

[0015] A luminous layer emits light efficiently by the reunion of the electron hole poured in from the hole-injection layer or the positive electrode, and the electron poured in from the negative electrode or the electron-injection layer. Although the membrane formation method has SUPINKO-TO, casting, the LB method, resistance heating vacuum evaporationo, electron beam evaporation, etc., its resistance heating vacuum evaporationo is common. Although thickness is 100 or 2000A, it is 200 or 800A suitably. A typical photogene is shown below.

[0016]

[Formula 2]



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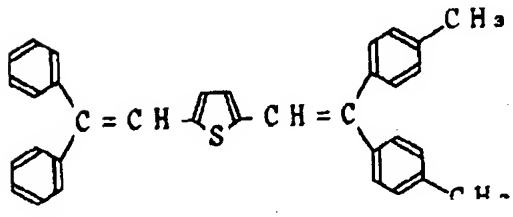

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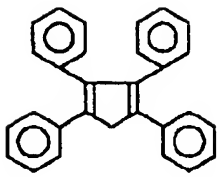

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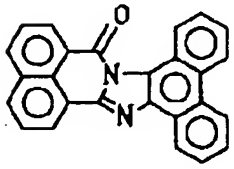

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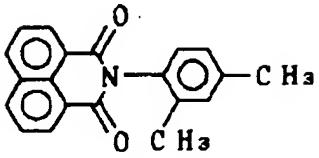
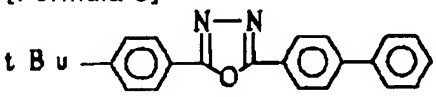


(6 - 5)

[0017] As for an electron-injection layer, it is desirable to pour an electron into a luminous layer efficiently. Although the membrane formation method has SUPINKO-TO, casting, the LB method, resistance heating vacuum evaporationo, electron beam evaporation, etc., its resistance heating vacuum evaporationo is common. Although thickness is 100 or 2000A, it is 200 or 800A suitably. An OKISA diazole derivative, a perylene derivative, etc. are used as electron-injection matter. The typical electron-injection matter is shown below.

[0018]

[Formula 3]



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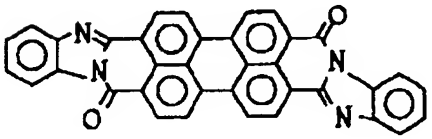

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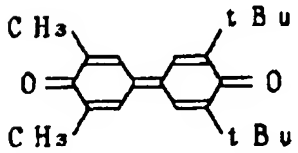


(7 - 3)

[0019] A negative electrode needs to inject an electron into an organic layer efficiently. As the membrane formation method, resistance heating vacuum evaporationo, electron beam evaporation, and a spatter are used. The zinc oxide which added these alloys and a layered product, and aluminum, such as Mg, Ag, In, calcium, aluminum, etc. with a small work function, as a charge of negative-electrode material is used. As for the zinc oxide which added

aluminum, it is desirable to consider as the aluminum addition 0.5 or 3% of range by electron beam evaporation and the spatter, and to form membranes below 100 degrees C suitably the substrate temperature of 200 degrees C or less. Thickness is formed in 100 or 2000A thickness. Semipermeable membrane, such as aluminum, is formed in 300 or 800A thickness by the resistance heating vacuum deposition.
Example 1 drawing 1 is the cross section showing the organic thin film light emitting device concerning the example of this invention. The glass substrate 11 which formed the positive electrode 12 which is ITO of about 1000A of thickness was laid in resistance heating vacuum evaporationo equipment, and membranes were formed one by one with the hole-injection layer 13 and the luminous layer 14. Vacuum tub internal pressure was set to 8x10 to 4 Pa on the occasion of membrane formation. It formed in 500A thickness using the compound shown in the aforementioned chemical formula (5-1) at the hole-injection layer 13 by 2A/s in the boat temperature of 200 degrees C, and membrane formation speed. It heated at the boat temperature of about 200 degrees C using the compound continuously shown in the aforementioned chemical formula (6-1) as a luminous layer 14, membrane formation speed was carried out in about 2A/s, and it formed in 600A thickness.
[0020] Then, the substrate 11 was taken out from the vacuum tub and it laid in the sputtering system, and the spatter was carried out by using as a target the sample which carried aluminum wire on the zinc pellet, passing the mixed gas of Ar:O 2 = 1:1, and the transparent negative electrode 15 which consists of an aluminum addition zinc oxide was formed in 1000A thickness. The visible-ray permeability of this aluminum addition zinc-oxide transparent negative electrode 15 is about 85%. Next, the sample was taken out from the sputtering system, and it laid in resistance heating vacuum evaporationo equipment again, and formed in the thickness of 500A in order of the luminous layer 16 and the hole-injection layer 17 under the same conditions using the same material as the aforementioned luminous layer 14 and the hole-injection layer 13. Finally Ag was formed in the thickness of 1000A as a positive electrode 18.
In the example of comparison 1 above-mentioned example, a luminous layer 16, the hole-injection layer 17, and a positive electrode 18 were not formed, and also the organic thin film light emitting device was formed like the example 1.
[0021] When both example 1 and example 1 of comparison impressed direct current voltage, uniform green (main wavelength : 550nm) luminescence was obtained. Brightness 100 cd/m2 The voltage which can be set, current density, luminous efficiency, and brightness half line are shown in Table 1.
[0022]
[Table 1]

	初期特性				輝度半減時間 (h)
	初期輝度 (cd/m^2)	電 圧 (V)	電流密度 (mA/cm^2)	発光効率 (lm/W)	
実施例1	100	10.7	2.8	0.52	880
比較例1	100	12.5	5.0	0.50	200

Since the two-step laminating of the joint object which consists of a hole-injection layer and a luminous layer in this example is carried out, the brightness which a single joint object pays can be low, can end, and can reduce the current density which a joint object single for the reason needs, and its life improves as the organic whole thin film light emitting device. Since joint [the first step of] object is covered on the whole, the invasion of the moisture to joint [the first step of] object is prevented, and the reliability of joint [the second more step of]

object of an organic thin film light emitting device improves.
[0023] Moreover, since the voltage concerning an element is compared with the one-step element of the example of comparison and it can decrease, equivalent [in luminous efficiency] or the improvement in some is found.
Example 2 drawing 2 is the cross section showing the organic thin film light emitting device concerning the example from which this invention differs. The transparent negative electrode 22 which consists of an aluminum addition zinc oxide was formed on the glass substrate 21 at the thickness of about 1000A of thickness. Next, the luminous layer 23 and the hole-injection layer 24 were formed one by one. The luminous layer 23 and the hole-injection layer 24 were created on the same conditions as an example 1.
[0024] The positive electrode 25 was formed in 700A thickness using the same resistance heating vacuum evaporationo equipment using Au. The light transmittance of this positive electrode is about 70%. The hole-injection layer 26 and the luminous layer 27 were succeedingly created one by one like the above. Finally, the alloy (Mg/Ag=10:1) of Mg and Ag was used and the negative electrode 28 was formed in 1000A thickness by the resistance heating vacuum deposition.
In the example of comparison 2 above-mentioned example, the hole-injection layer 26, a luminous layer 27, and a negative electrode 28 were not formed, and also the organic thin film light emitting device was formed like the example 2.
[0025] When both example 2 and example 2 of comparison impressed direct current voltage, uniform green (main wavelength : 550nm) luminescence was obtained. Brightness 100 cd/m2 The voltage which can be set, current density, luminous efficiency, and brightness half line are shown in Table 2.
[0026]
[Table 2]

	初期特性				輝度半減時間 (h)
	初期輝度 (cd/m^2)	電 圧 (V)	電流密度 (mA/cm^2)	発光効率 (lm/W)	
実施例2	100	10.5	3.55	0.35	820
比較例2	100	13.6	6.3	0.36	193

Example 3 drawing 3 is the cross section showing the organic thin film light emitting device concerning the example from which this invention differs further. The transparent negative electrode 32 which consists of an aluminum addition zinc oxide was formed on the glass substrate 31 at the thickness of about 1000A of thickness. Next, the electron-injection layer 33, the luminous layer 34, and the hole-injection layer 35 were formed one by one. The electron-injection layer was heated at the boat temperature of about 300 degrees C using the aforementioned chemical formula (7-2), and was formed in 400A thickness as 2A/s in membrane formation speed. The luminous layer 34 and the hole-injection layer 35 were created on the same conditions as an example 1.
[0027] The positive electrode 36 was formed in 700A thickness using the same resistance heating vacuum evaporationo equipment using Au. The light transmittance of this positive electrode is about 70%. The hole-injection layer 37, the luminous layer 38, and the electron-injection layer 39 were succeedingly created one by one like the above. Finally, the alloy (Mg/Ag=10:1) of Mg and Ag was used and the negative electrode 300 was formed in 1000A thickness by the resistance heating vacuum deposition.
In the example of comparison 3 above-mentioned example 3, the hole-injection layer 37, a luminous layer 38, and a negative electrode 300 were not formed, and also the organic thin

film light emitting device was formed like the example 3.
[0028] When both example 3 and example 3 of comparison impressed direct current voltage, uniform green (main wavelength : 550nm) luminescence was obtained. Brightness 100 cd/m2 The voltage which can be set, current density, luminous efficiency, and brightness half line are shown in Table 3.
[0029]
[Table 3]

	初期特性				輝度半減時間 (h)
	初期輝度 (cd/m²)	電 圧 (V)	電流密度 (mA/cm²)	発光効率 (lm/W)	
実施例3	100	12.3	3.40	0.38	850
比較例3	100	13.1	6.1	0.39	195

Example 4 drawing 4 is the cross section showing the organic thin film light emitting device concerning the example from which this invention differs further. The transparent negative electrode 42 which consists of an aluminum addition zinc oxide was formed on the glass substrate 41 at the thickness of about 1000A of thickness. Next, the luminous layer 43 and the hole-injection layer 44 were formed one by one. The luminous layer 43 and the hole-injection layer 44 were created on the same conditions as an example 1.
[0030] The positive electrode 46 was formed in 700A thickness using the same resistance heating vacuum evaporationo equipment using Au. The light transmittance of this positive electrode is about 70%. The hole-injection layer 47, the luminous layer 48, the negative electrode 49, the luminous layer 50, and the hole-injection layer 51 were succeedingly created like the above. The positive electrode 52 formed 1000A of Ag. As for this element, the triad laminating of the joint object of a hole-injection layer and a luminous layer is carried out. It is the same as that of the example 2 of the example of comparison 4 aforementioned comparison.
[0031] When both example 4 and example 4 of comparison impressed direct current voltage, uniform green (main wavelength : 550nm) luminescence was obtained. Brightness 100 cd/m2 The voltage which can be set, current density, luminous efficiency, and brightness half line are shown in Table 4.
[0032]
[Table 4]

	初期特性				輝度半減時間 (h)
	初期輝度 (cd/m²)	電 圧 (V)	電流密度 (mA/cm²)	発光効率 (lm/W)	
実施例4	100	9.3	2.4	0.47	1300
比較例4	100	12.5	5.0	0.50	200

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The cross section showing the organic thin film light emitting device concerning the example of this invention
[Drawing 2] The cross section showing the organic thin film light emitting device concerning the example from which this invention differs
[Drawing 3] The cross section showing the organic thin film light emitting device concerning the example from which this invention differs further
[Drawing 4] The cross section showing the organic thin film light emitting device concerning the example from which this invention differs further
[Description of Notations]
11, 21, 31, 41 Insulating transparent substrate
12, 18, 25, 36, 46, 52 Positive electrode
13, 17, 24, 26, 35, 37, 44, 47, 51 Hole-injection layer
14, 16, 23, 27, 34, 38, 43, 48, 50 Luminous layer
15, 22, 28, 32, 42, 49,300 Negative electrode
33 39 Electron-injection layer
19, 29, 301, 45 DC power supply

[Translation done.]

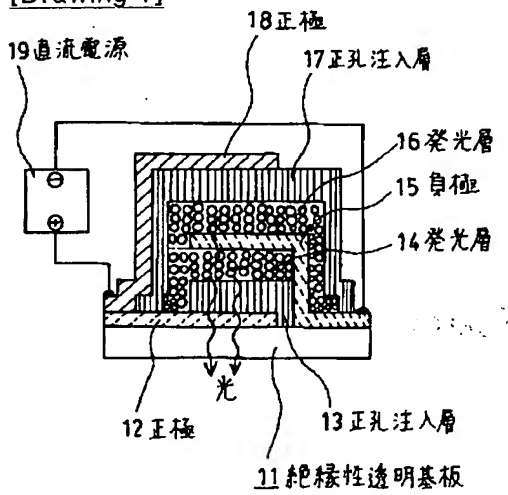
* NOTICES *

Japan Patent Office is not responsible for any damages caused by the use of this translation.

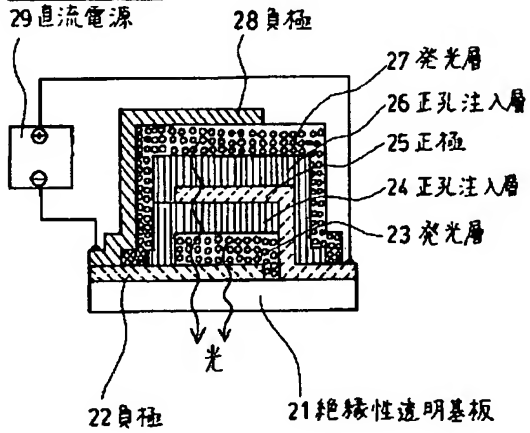
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

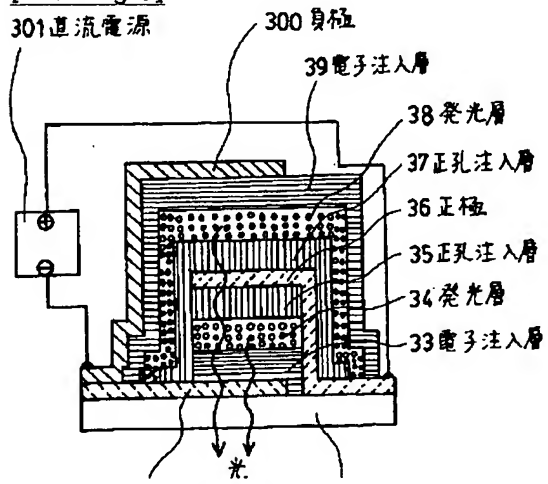
[Drawing 1]



[Drawing 2]

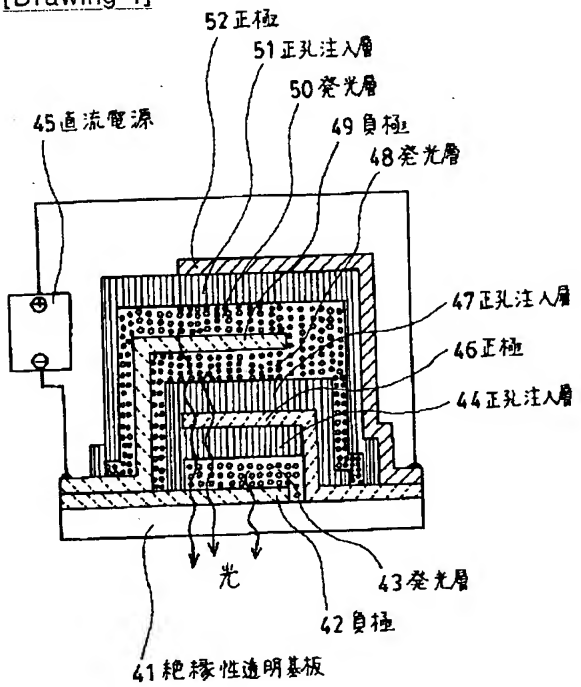


[Drawing 3]



32 負極　　31 絶縁性透明基板

[Drawing 4]



[Translation done.]